8.1 Products and Powers

MATERIALS • paper and pencil

QUESTION **How can you find a product of powers and a power of a power?**

EXPLORE 1 **Find products of powers**

STEP 1 ***Copy and complete*** Copy and complete the table.

Expression	Expression as repeated multiplication	Number of factors	Simplified expression
$7^4 \cdot 7^5$	$(7 \cdot 7 \cdot 7 \cdot 7) \cdot (7 \cdot 7 \cdot 7 \cdot 7 \cdot 7)$	9	7^9
$(-4)^2 \cdot (-4)^3$	$[(-4) \cdot (-4)] \cdot [(-4) \cdot (-4) \cdot (-4)]$	?	?
$x^1 \cdot x^5$	?	?	?

STEP 2 ***Analyze results*** Find a pattern that relates the exponents of the factors in the first column and the exponent of the expression in the last column.

EXPLORE 2 **Find powers of powers**

STEP 1 ***Copy and complete*** Copy and complete the table.

Expression	Expanded expression	Expression as repeated multiplication	Number of factors	Simplified expression
$(5^3)^2$	$(5^3) \cdot (5^3)$	$(5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5)$	6	5^6
$[(-6)^2]^4$	$[(-6)^2] \cdot [(-6)^2] \cdot [(-6)^2] \cdot [(-6)^2]$	?	?	?
$(a^3)^3$	?	?	?	?

STEP 2 ***Analyze results*** Find a pattern that relates the exponents of the expression in the first column and the exponent of the expression in the last column.

DRAW CONCLUSIONS **Use your observations to complete these exercises**

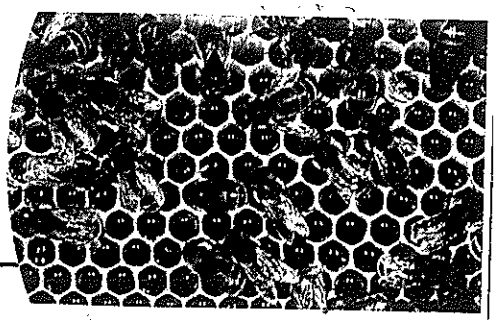
Simplify the expression. Write your answer using exponents.

1. $5^2 \cdot 5^3$
2. $(-6)^1 \cdot (-6)^4$
3. $m^6 \cdot m^4$
4. $(10^3)^3$
5. $[(-2)^3]^4$
6. $(c^2)^6$

In Exercises 7 and 8, copy and complete the statement.

7. If a is a real number and m and n are positive integers, then $a^m \cdot a^n =$?.
8. If a is a real number and m and n are positive integers, then $(a^m)^n =$?.

8.1 Apply Exponent Properties Involving Products



Before You evaluated exponential expressions.

Now You will use properties of exponents involving products.

Why? So you can evaluate agricultural data, as in Example 5.

Key Vocabulary
- **order of magnitude**
- **power,** *p. 3*
- **exponent,** *p. 3*
- **base,** *p. 3*

Notice what happens when you multiply two powers that have the same base.

$$a^2 \cdot a^3 = \overbrace{(a \cdot a)}^{\text{2 factors}} \cdot \overbrace{(a \cdot a \cdot a)}^{\text{3 factors}} = a^5 = a^{2+3}$$

(5 factors)

The example above suggests the following property of exponents, known as the product of powers property.

KEY CONCEPT *For Your Notebook*

Product of Powers Property

Let a be a real number, and let m and n be positive integers.

Words To multiply powers having the same base, add the exponents.

Algebra $a^m \cdot a^n = a^{m+n}$ **Example** $5^6 \cdot 5^3 = 5^{6+3} = 5^9$

PLIFY ESSIONS
- simplifying
- with numerical
- only, write
- owers using
- nts, as in parts
- nd (c).

EXAMPLE 1 **Use the product of powers property**

a. $7^3 \cdot 7^5 = 7^{3+5} = 7^8$

b. $9 \cdot 9^8 \cdot 9^2 = 9^1 \cdot 9^8 \cdot 9^2$

$= 9^{1+8+2}$

$= 9^{11}$

c. $(-5)(-5)^6 = (-5)^1 \cdot (-5)^6$

$= (-5)^{1+6}$

$= (-5)^7$

d. $x^4 \cdot x^3 = x^{4+3} = x^7$

✓ **GUIDED PRACTICE** for Example 1

Simplify the expression.

1. $3^2 \cdot 3^7$
2. $5 \cdot 5^9$
3. $(-7)^2(-7)$
4. $x^2 \cdot x^6 \cdot x$